material. The equilibrium points between absorption and desorption for a given pressure is defined by the intersection of the x-axis;

[0033] FIG. **2** is a flow chart for sequential desorption of manifolded metal hydride cylinders based on digital mass flow meter integration;

[0034] FIG. **3** is a flow chart for sequential desorption of manifolded metal hydride cylinders based on heater power integration;

[0035] FIG. **4** is a process and instrumentation diagram showing configuration of passive gas valves;

[0036] FIG. **5** is a FEA simulation of temperature profile of a cylinder cooling under 1.1 bara.; and

[0037] FIG. **6** is a FEA simulation of concentration profile of a cylinder cooling under 1.1 bara.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0038] Referring to FIG. **4**, the connection of hydrogen storage vessels **1**A, **1**B, **1**C is schematically shown. The hydrogen storage vessels are filled with a suitable hydrogen storage material such as MgH_2 or other hydride forming alloy which absorbs hydrogen above a predetermined temperature and pressure and desorbs hydrogen when the temperature is raised above the desorption temperature. The vessels are connected in parallel by a common desorption gas manifold **2** to a hydrogen supply line **3**. The supply line **3** is generally on site where the hydrogen storage vessels are delivered to meet a hydrogen demand at the site.

[0039] A hydrogen conduit **4**A, **4**B, **4**C is connectable to the hydrogen storage vessels IA, IB, IC respectively to receive hydrogen gas discharged from that vessel. A hydrogen storage vessel containing hydrogen storage material such as magnesium hydride discharge hydrogen under a constant pressure when heated to the absorption temperature. Hydrogen continues to be discharged until it is substantially empty at which time the discharge pressure drops dramatically.

[0040] The hydrogen discharge conduits **4**A, **4**B, **4**C connecting to the hydrogen desorption manifold are preferably provided with backflow prevention devices **5**A, **5**B, **5**C such as one way valves which prevent hydrogen gas in the manifold from returning to the discharge/spent/depleted hydrogen storage vessel **1**A, **1**B, IC respectively. As the decrease in discharge pressure from the hydrogen storage vessel occurs close to the point at which the hydrogen storage vessel is totally depleted, it is essential for the continual supply of hydrogen to the hydrogen supply line that the next hydrogen storage vessel to supply hydrogen is heated to the required desorption temperature by the time that the pressure begins to decrease in the nearly depleted hydrogen storage vessel.

[0041] A process controller **7** monitors the desorption process in the discharging hydrogen storage vessel and commences heating the next hydrogen storage vessel at an appropriate time prior to the pressure drop to ensure continuity of supply. This is done by activating heating element **6**A, **6**B, **6**C at the appropriate time. The operation of the controller will be described in more detail later. The heating elements may be electrical heating elements which are located either internally or externally of the hydrogen storage vessels. To enhance the effects of the heating an insulated heating jacket may be provided during the heating and desorption operation. Once the hydrogen storage vessel **1**A, **1**B, **1**C has finished discharging hydrogen, the energy source to the heating element of the hydrogen storage vessel is deactivated and the hydrogen storage material is allowed to cool. Ideally any insulated jacket may be removed when the heating elements deactivated. As illustrated in FIG. **1**, once the hydrogen storage material cools below the equilibrium temperature (in the direction of arrow T), the kinetics for the absorption/the absorption reaction favours absorption of hydrogen. Hence all hydrogen available to the hydrogen storage material is absorbed potentially creating a negative pressure (ie. pressure below atmospheric, 1 bar absolute) in the hydrogen storage vessel.

[0042] If it is desirable to prevent pressure in the hydrogen storage vessel dropping below atmospheric pressure, an ancillary supply source communicates with the exhausted hydrogen storage vessel at least during cooling. The ancillary supply source may be provided to the supply conduit **8**A, **8**B, **8**C through a backflow prevention device **9**A, **9**B, **9**C such as a one way valve. The ancillary supply source may be a separate hydrogen supply **11** such as a gas cylinder through a valve **12** or it may be a branch line **8** from the absorption gas manifold. The branch line **8** is provided with a pressure control valve to step down the pressure from the absorption manifold supply pressure to a pressure that is slightly above atmospheric ie. preferably in the range of 1-2 bar absolute. While the absorption/desorption reaction is in absorption cycle during the cool down stage of the hydrogen storage material, the reaction kinetics is very slow at that pressure so only a small volume of the hydrogen is actually absorbed.

[0043] It may be acceptable to allow a vacuum to develop in the hydrogen storage vessel and so no ancillary source need be provided. Alternatively the vacuum may be filled with other gases such as argon, nitrogen or air supplied separately or air may be intentionally allowed to leak in and fill the vacuum.

[0044] To further limit the amount of hydrogen reabsorbed into the cooling emptied hydrogen storage cylinder, the rate of cooling of the hydrogen storage material may be increased by improving the cooling of the emptied cylinder by either or both passive or active cooling of the cylinder and as shown in FIG. **1** reduce the reaction rate of the hydrogen absorbing onto the hydrogen storage material. Passive cooling may take the form of removing any external insulation which may be covering the exterior of the cylinder and active cooling may involve the use of an air blower over the exterior surface of the emptied cylinder or the use of a water-cooled jacket

[0045] The operation of the process controller will now be described. The individual control and sequential desorption of each pressure cylinder minimises heat loss by ensuring only one cylinder is actively desorbing. An additional cylinder is pre-heated at an appropriate time to seamlessly take over the supply of hydrogen once the active cylinder empties. The remaining cylinders are stored at room temperature until required

[0046] The operation of the system can be simplified as follows

[0047] 1. Cylinder A desorbing

[0048] 2. Cylinder A reaches 80% depth of discharge and initiates warm-up of Cylinder B (taking 15 minutes)

[0049] 3. Cylinder B begins desorbing automatically as soon as it reaches temperature. At this stage cylinder A is still not 100% empty. Cylinder A continues to desorb slowly in parallel with Cylinder B.

[0050] 4. Cylinder B reaches 20% depth of discharge and initiates cool-down of cylinder A.